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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/721,605	11/25/2003	Chih-Hao Wang	MXIC 1516-1	5625
22470	7590	02/09/2005	EXAMINER	
HAYNES BEFFEL & WOLFELD LLP			KANG, DONGHEE	
P O BOX 366			ART UNIT	
HALF MOON BAY, CA 94019			PAPER NUMBER	
			2811	

DATE MAILED: 02/09/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/721,605

Applicant(s)

WANG ET AL.

Examiner

Donghee Kang

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 January 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-73 is/are pending in the application.
- 4a) Of the above claim(s) 71-73 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-70 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 03/26/04.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Claims 71-73 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 01-13-05.

Information Disclosure Statement

2. Acknowledgment is made of receipt of applicant's Information Disclosure Statement (PTO-1449) filed March 16, 2004.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims **1-4, 8, & 16** are rejected under 35 U.S.C. 102(e) as being anticipated by Yoo et al. (US 2004/0009642).

Re claim 1, Yoo et al. teach a method for forming an ONO structure, comprising (Figs. 2-5):

Providing an oxide-nitride film (212 & 214) on a surface of a substrate (200), the oxide-nitride film including a first oxide layer (212) over the substrate and a silicon nitride layer (214) over the first oxide layer (Fig.2); patterning the oxide-nitride film

(Fig.3) to define bottom oxide and silicon nitride portions of an ONO stack on the substrate, the bottom oxide and silicon nitride portions (210') having exposed sidewalls and the silicon nitride portion having an exposed surface (see paragraph 0022); and exposing the exposed sidewalls and the exposed surface to a rapid thermal oxidation in an ambient containing a radical oxidizing agent (paragraph 0026), to form an oxide layer (219, Fig.4) on the exposed surface and sidewalls of the patterned silicon nitride portion and on the sidewalls of the patterned bottom oxide portion. See also paragraph 0012-0014 & 0021-0027.

Re claims 2-3, Yoo et al. teach the radical oxidizing agent comprises O* (paragraph 0026).

Re claims 4 & 8, Yoo et al. teach the exposing comprises heating the substrate to a selected temperature and exposing the exposed sidewalls and the exposed surface to a mixture of O₂ and H₂ in a selected proportion at a selected pressure and for a selected time, whereby components of the O₂ and H₂ react to produce O* near the heated substrate.

Re claims 16, Yoo et al. teach the exposing comprises heating the substrate in a furnace and flowing into the furnace a mixture of O₂ and H₂ in a selected proportion at a selected pressure and for a selected time, whereby components of the O₂ and H₂ react to produce O* near the heated substrate.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 2811

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims **5-7 & 9-15** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo et al. (US 2004/0009642).

Re claims 5-7, Yoo et al. teach heating the substrate comprises heating the substrate to a temperature in a range about 500°C to about 1150°C. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the temperature range of heating in order to obtain a high quality insulating layer.

Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the temperature to oxidizing, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

See also MPEP 2144.05. In the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a prima facie case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed.Cir. 1990) (The prior art taught carbon monoxide concentrations of “about 1-5%” while the claim was limited to “more than 5%.” The court held that “about 1-5%” allowed for concentrations slightly above 5% thus the ranges overlapped.); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed. Cir. 1997) (Claim reciting thickness of a protective layer as falling within a range of “50 to 100 Angstroms”

Art Unit: 2811

considered prima facie obvious in view of prior art reference teaching that “for suitable protection, the thickness of the protective layer should be not less than about 10 nm [i.e., 100Angstroms].” The court stated that “by stating that suitable protection’ is provided if the protective layer is about’ 100 Angstroms thick, [the prior art reference] directly teaches the use of a thickness within [applicant’s] claimed range.”).

Re claims 9-15, Yoo et al. teach heating temperature between 500 and 1150°C and pressure between 1-760 torr. Yoo et al. do not explicitly teach a specific portion of mixture of O₂ and H₂ and pressure time. It is an obvious matter of routine experimentation to find the optimal mixture and pressure time ranges.

7. Claims **17-18 & 20-22** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo et al. in view of Ikakura et al. (US 6,255,230).

Yoo et al. do not explicitly teach flowing the mixture of O₂ and H₂ further comprises flowing N₂ as a carrier gas. Ikakura et al. teach N₂ gas as a carrier gas (Col.9, lines 13-14). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use N₂ as a carrier gas since the carrier gas may help flowing an oxygen radical hence improving the oxide layer quality.

8. Claims **23-37, 40, 42, 44-61, 64, 66 & 68-70** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo et al. (US 2004/0009642) in view of admitted prior art (Fig.2).

Re claim 23, 27-28, 47 & 51-52, Yoo et al. teach a method for manufacturing a memory device having an ONO structure, comprising (Figs. 2-5):

providing an oxide-nitride film (212 & 214) on a surface of a substrate (200), the oxide-nitride film including a first oxide layer (212) over the substrate and a silicon nitride layer (214) over the first oxide layer (Fig.2); patterning the oxide-nitride film (Fig.3) to define bottom oxide and silicon nitride portions of an ONO stack on the substrate, the bottom oxide and silicon nitride portions (210') having exposed sidewalls and the silicon nitride portion having an exposed surface (see paragraph 0022); and exposing the exposed sidewalls and the exposed surface to a rapid thermal oxidation in an ambient containing a radical oxidizing agent (paragraph 0026) while the substrate is at a temperature in a range about 500°C to about 1150°C, to form currently a second oxide layer (219, Fig.4) on the exposed surface and sidewalls of the patterned silicon nitride portion and a gate oxide layer on the substrate surface in the second region and forming a conductive layer (240, Fig.5) over the second oxide layer and over the gate oxide layer. See also paragraph 0012-0014 & 0021-0027.

Yoo et al. do not explicitly teach the claimed temperature. It is an obvious matter of routine experimentation to find the optimal temperature ranges. See statement of rejection for claims 5-7.

Yoo et al. do not teach isolation to separate the substrate two regions. APA teaches in Fig.2 forming isolation region (204) in the substrate (202) to separate the substrate. Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to form isolation region in the substrate as taught by APA in the Yoo's method in order to provide separation region in the substrate.

Re claims 24-25 & 48-49, Yoo et al. teach the radical oxidizing agent comprises O* (paragraph 0026).

Re claims 26, 29, 50, & 53, Yoo et al. teach the exposing comprises heating the substrate to a selected temperature and exposing the exposed sidewalls and the exposed surface to a mixture of O₂ and H₂ in a selected proportion at a selected pressure and for a selected time, whereby components of the O₂ and H₂ react to produce O* near the heated substrate.

Re claims 30-36, 40, 42, 44-46, 54-61, 64, 66& 68-70, Yoo et al. teach heating temperature between 500 and 1150°C and pressure between 1-760 torr. Yoo et al. do not explicitly teach a specific portion of mixture of O₂ and H₂ and pressure time. It is an obvious matter of routine experimentation to find the optimal mixture and pressure time ranges.

Re claim 37, Yoo et al. teach the exposing comprises heating the substrate in a furnace and flowing into the furnace a mixture of O₂ and H₂ in a selected proportion at a selected pressure and for a selected time, whereby components of the O₂ and H₂ react to produce O* near the heated substrate.

9. Claims **38-39, 41-43, 63-63, 65 & 67** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yoo et al. in view of APA, as applied to claims 23 & 47 above, and further in view of Ikakura et al. (US 6,255,230).

Yoo et al. do not explicitly teach flowing the mixture of O₂ and H₂ further comprises flowing N₂ as a carrier gas. Ikakura et al. teach N₂ gas as a carrier gas (Col.9, lines 13-14). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use N₂ as a carrier gas since the carrier gas may help flowing an oxygen radical hence improving the oxide layer quality.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Yoshino (US 2003/0185071)

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Donghee Kang whose telephone number is 571-272-1656. The examiner can normally be reached on Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should

Art Unit: 2811

you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Donghee Kang, Ph.D.
Primary Examiner
Art Unit 2811

dhk